there is a distinct and prominent septum in each valve; and the laminar ridge in the smaller valve is much slighter, and is interrupted by the septum to which it is attached. Both species occur together on the English and Irish coasts, and at Etretat in Normandy; and *A. capsula* was recorded by the late Prof. Sars as fossil at Kirköen, near Christiania.

Notes on the Early Stages of some Polychætous Annelides.

By E. B. Wilson.

In view of the morphological interest of the marine annelides as the most highly specialized forms among the "Vermes," and the scarcity of detailed accounts of their early stages of development, the following preliminary abstract of studies on the eggs of *Arenicola* and *Clymenella* seems of some interest. The eggs are small and very numerous, and are imbedded in transparent gelatinous masses issuing from the mouths of the tubes or burrows inhabited by the worms. The egg-masses of *Arenicola* are of great size, being sometimes 5 or 6 feet in length and from 2 to 4 inches in diameter; such a mass must contain several hundred thousand eggs. Those of *Clymenella* are usually about the size and shape of a pigeon's egg; the eggs are much fewer and considerably larger than those of *Arenicola*.

The whole course of development is essentially alike in the two forms. No polar globules of constant relation to the yolk were observed. The first cleavage divides the egg into two unequal spherules. The second, passing at right angles to the first, divides the smaller spherule into two equal parts, and the larger into two unequal parts. The third cleavage separates from these four blastomeres four much smaller ones at one pole of the egg. The latter (micromeres) soon become so displaced as to alternate with the former (macromeres). The micromeres now divide more rapidly than the macromeres, which they come ultimately to include by growing down over them. The ectoderm is formed by the derivatives of the micromeres, and in part, I believe, of the macromeres. The remaining portions of the macromeres form the entoderm. Two large spherules, which originally formed a part of the largest of the four primary blastomeres, are visible up to a late stage at the posterior extremity of the embryo. They are at first at the surface, but ultimately are grown over by the ectoderm and disappear. It is possible that they are concerned in the formation of the mesoderm and are to be regarded as primary mesoblasts. The mouth arises on the ventral side nearly opposite that pole of the egg where the first four micromeres were formed. The anus arises at the posterior end of the embryo. The egg-membrane is directly converted into the cuticle of the larva. The egg exhibits, during segmentation, alternate periods of activity and quiescence.

The embryo acquires two dorsal eye-specks, præoral and præ-

anal belts of cilia, and a broad ventral band, and becomes a "Telotrochous" larva which passes directly into the adult. The setæ develop from before backwards; and those of the dorsal ramus appear before those of the ventral.

The segmentation is closely similar to that of some Oligochæta (*Euaxes*, *Tubifex*), and resembles also that of the leeches. The gastrula stage is not attained by a typical invagination, but by a downgrowth of the ectoderm over the entoderm.—*Amer. Journ. Sci.* Oct. 1880.

Beaufort, N. C., July 1880.

The Rhythmical Character of the Process of Segmentation.

By W. H. Brooks.

A number of observers have called attention to the fact that in certain animals the segmenting eggs pass through alternating stages, in which the segmentation-products are first conspicuous and well defined and then flattened and fused together.

In a paper on the development of the freshwater pulmonates I have attempted to show that the alternation is due to the fact that periods of segmenting activity alternate with periods of rest, and that the tendency which the elasticity of the egg exerts to render its form spherical when no other force is acting upon it causes the partial obliteration of the outlines of the spherules during each resting stage.

The essential factor is therefore the alternation of rest with activity; and the change of shape during the resting periods is a secondary phenomenon, brought about incidentally by the physical properties of the yolk.

In most eggs the yolk is not sufficiently elastic to allow any great change of form; but careful time-records show that the process of segmentation is rhythmical, and that short periods of active change alternate with longer periods during which there is no external change.

During the past year various members of the Biological Department of the Johns Hopkins University have observed this alternation in various vertebrate and invertebrate eggs. Dr. Clarke has noticed it in an amphibian, *Amblystoma*, where the segmentation is total. I have observed it in the egg of an unknown fish, where segmentation is restricted to a blastoderm. Mr. Wilson has observed it in three annelides, where segmentation is total and irregular—*Arenicola*, *Clymenella*, and *Lumbricus*. It is very well marked in an arthropod, *Leucifer*, whose eggs undergo total regular segmentation.

Its occurrence in so many widely separated groups with such different methods of segmentation renders it probable that it will be found in nearly all eggs upon sufficiently careful examination.—*Amer. Journ. Sci.* Oct. 1880.